Ch. 3

MULTIVIBRATORS

Dr. Mohamed Salah

Bistable Multivibrators

Have two stable states.

If a trigger of the correct polarity and amplitude is applied to the circuit, it will change states and remain there until triggered again.

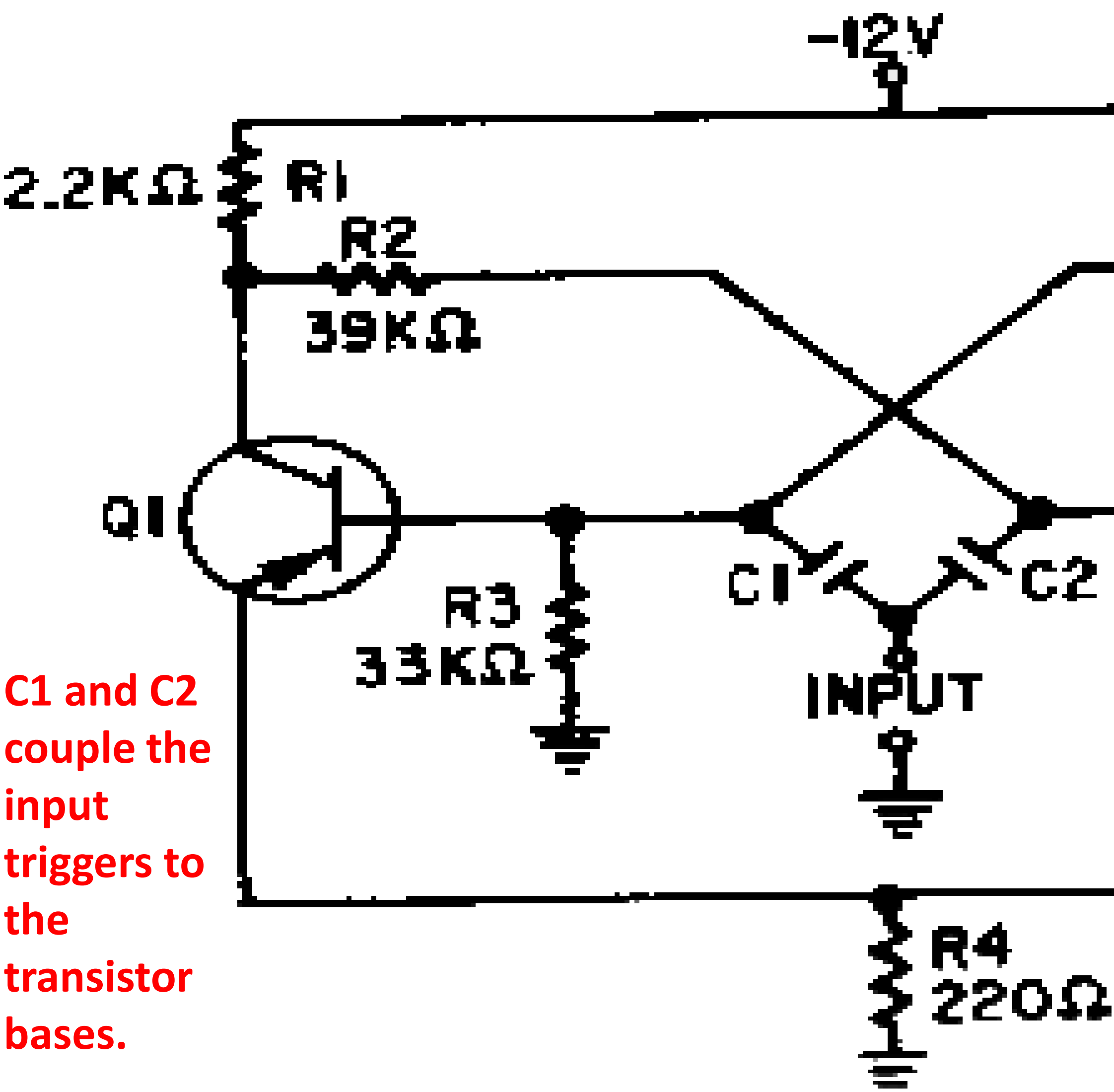
The trigger need not have a fixed pulse repetition frequency; in fact, triggers from different sources, occurring at different times, can be used to switch this circuit.

In the bistable multivibrator, both the resistive and the capacitive networks are replaced by resistive networks (just resistors or direct coupling).

Bistable Multivibrators

Voltage dividers R_1, R_2, and R_5 provide forward bias for Q_2; R_7, R_6, and R_3 provide forward bias for Q_1

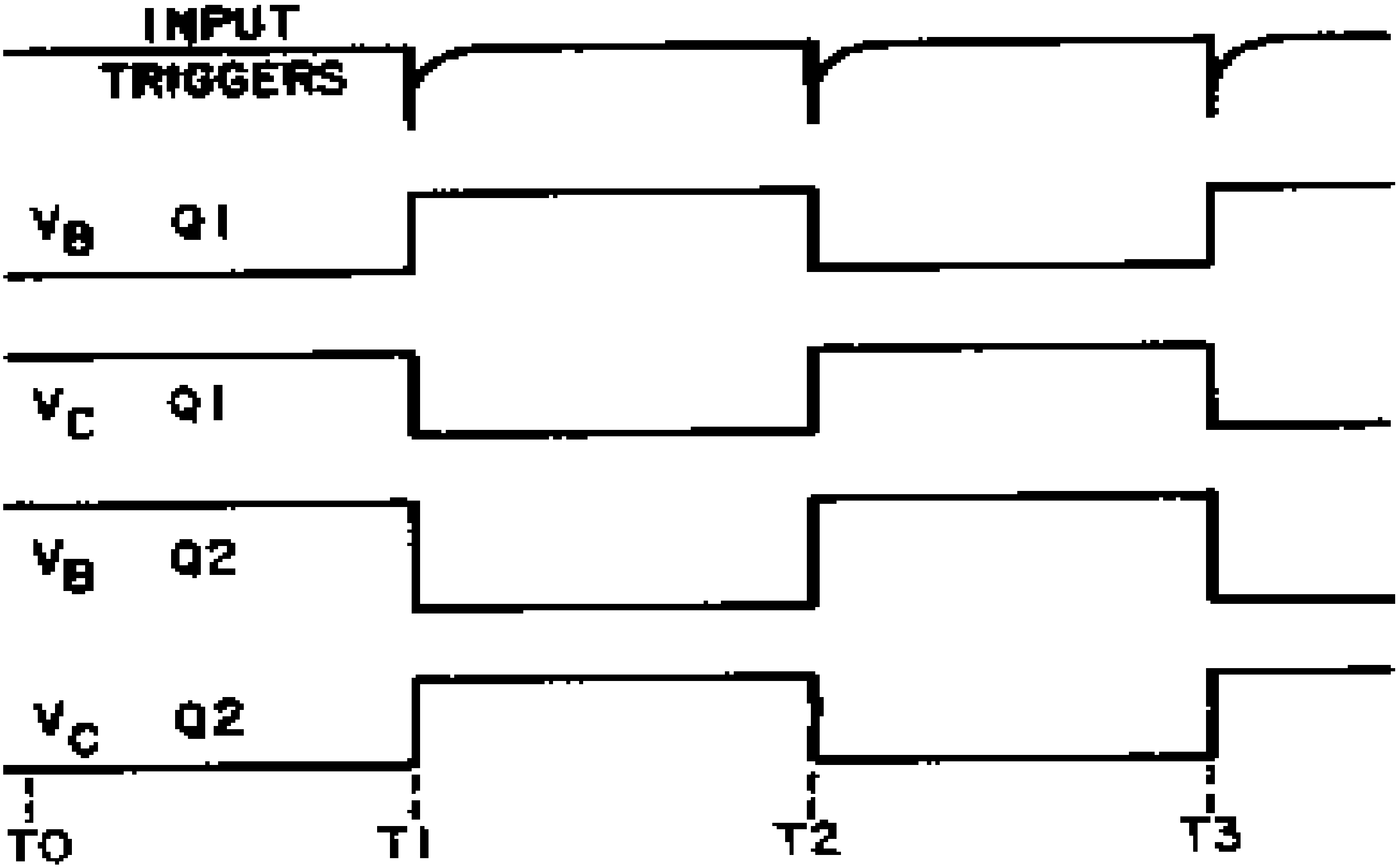
In this circuit, R_1 and R_7 are the collector load resistors.



C1 and C2 couple the input triggers to the transistor bases.

Both transistors use common emitter resistor R_4 which provides emitter coupling

Bistable Multivibrators



Bistable Multivibrators

Notice that the circuit is symmetrical; that is, each transistor amplifier has the same component values. When power is first applied, the voltage divider networks place a negative voltage at the bases of Q_1 and Q_2. Both transistors have forward bias and both conduct.

Due to some slight difference between the two circuits, one transistor will conduct more than the other.

Bistable Multivibrators

Assume that Q1 conducts more than Q2.

The increased conduction of Q1 causes the collector voltage of Q1 to be less negative (more voltage drop across R1).

This decreases the forward bias of Q2 and decreases the conduction of Q2.

When Q2 conducts less, its collector voltage becomes more negative.

The negative-going change at the collector of Q2 is coupled to the base of Q1 and causes Q1 to conduct even more heavily.

This regenerative action continues until Q2 is cut off and Q1 is saturated.

The circuit is in a stable state and will remain there until a trigger is applied to change the state.

Bistable Multivibrators

At T1, a negative trigger is applied to both bases through C1 and C2. The trigger does not affect Q1 since it is already conducting. The trigger overcomes cutoff bias on Q2 and causes it to conduct. As Q2 goes into conduction, its collector voltage becomes positive. The positive-going change at the Q2 collector causes a reverse bias on the base of Q1. As the conduction of Q1 decreases to the cutoff point, the collector voltage becomes negative. This switching action causes a very rapid change of state with Q2 now conducting and Q1 cut off.

Bistable Multivibrators

At T2, a negative trigger is again applied to both bases. This time, Q1 is brought into conduction and the regenerative switching action cuts off Q2. The bistable multivibrator will continue to change states as long as triggers are applied.

Notice that two input triggers are required to produce one gate; one to turn it on and the other to turn it off. The input trigger frequency is twice the output frequency.

The bistable multivibrator that most technicians know is commonly known by other names: the ECCLES-JORDAN circuit and, more commonly, the FLIP-FLOP circuit

Bistable Multivibrators

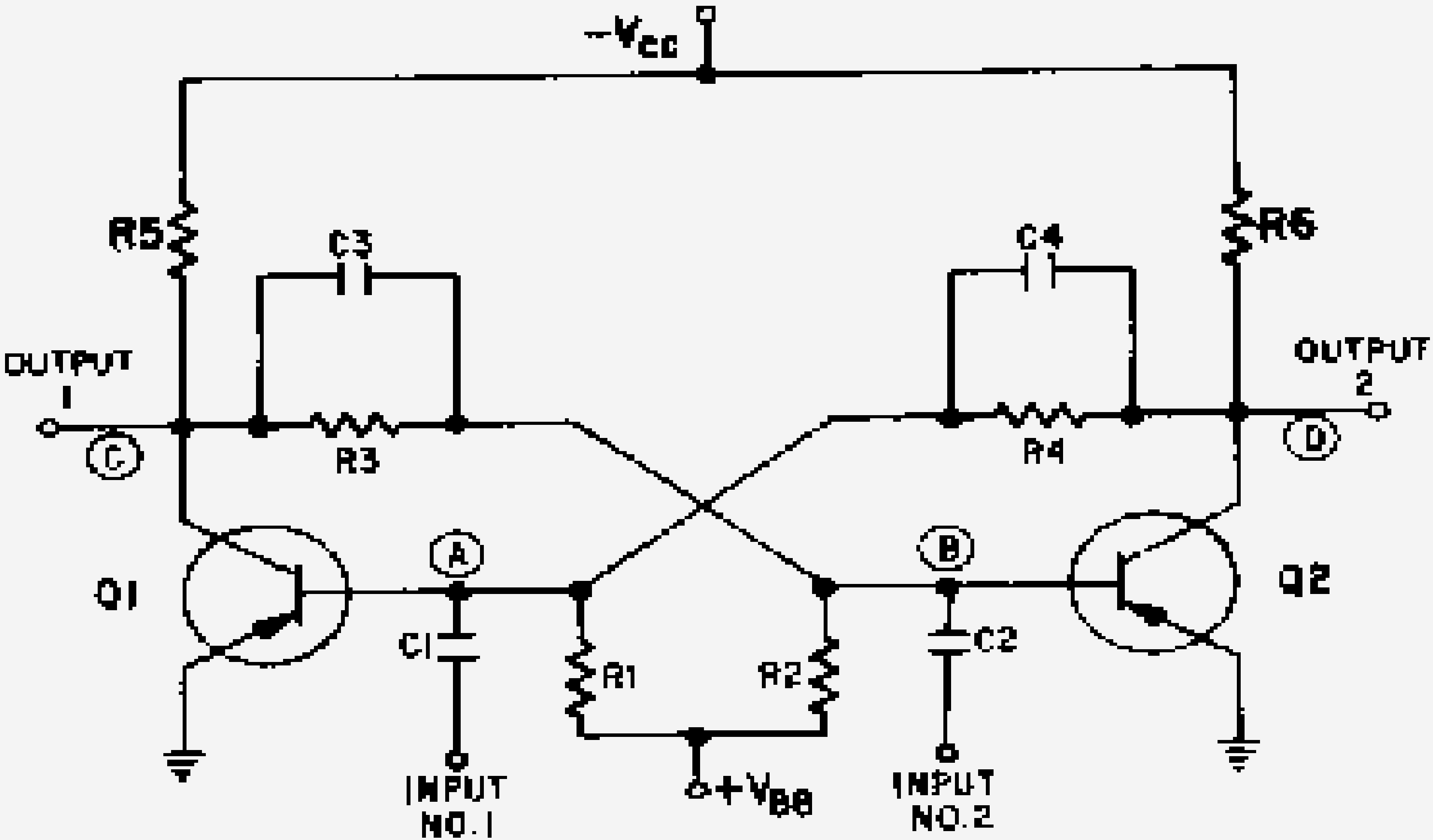
The flip-flop is a bistable multivibrator, "bi" meaning two; that is, the flip-flop has two stable states. The flip-flop (f/f) can rapidly flip from one state to the other and then flop back to its original state.

Flip-flops are used in switching-circuit applications (computer logic operations) as counters, shift registers, clock pulse generators, and in memory circuits. They are also used for relay-control functions and for a variety of similar applications in radar and communications systems.

2 inputs

2 outputs

Bistable Multivibrators

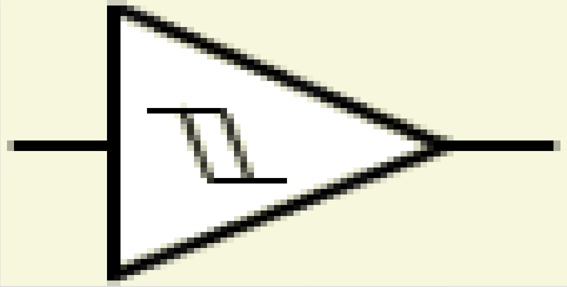


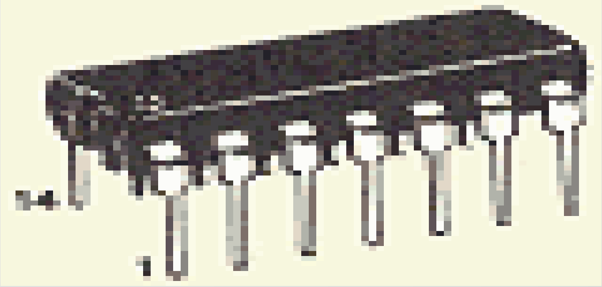
Schmitt Trigger

Is a decision-making circuit.

It is used to convert a slowly varying analogue signal voltage into one of two possible binary states, depending on whether the analogue voltage is above or below a preset threshold value.

A comparator can do much the same job.





Schmitt Trigger

A Schmitt trigger is a comparator circuit with hysteresis, implemented by applying positive feedback to the noninverting input of a comparator or differential amplifier. It is an active circuit which converts an analog input signal to a digital output signal. The circuit is named a "trigger" because the output retains its value until the input changes sufficiently to trigger a change. In the non-inverting configuration, when the input is higher than a certain chosen threshold, the output is high. When the input is below a different (lower) chosen threshold, the output is low, and when the input is between the two levels, the output retains its value.

Schmitt Trigger

Schmitt trigger devices are typically used in signal conditioning applications to remove noise from signals used in digital circuits, particularly mechanical switch bounce. They are also used in closed loop negative feedback configurations to implement relaxation oscillators, used in function generators and switching power supplies.

Schmitt Trigger

V_P, V_N

Operation

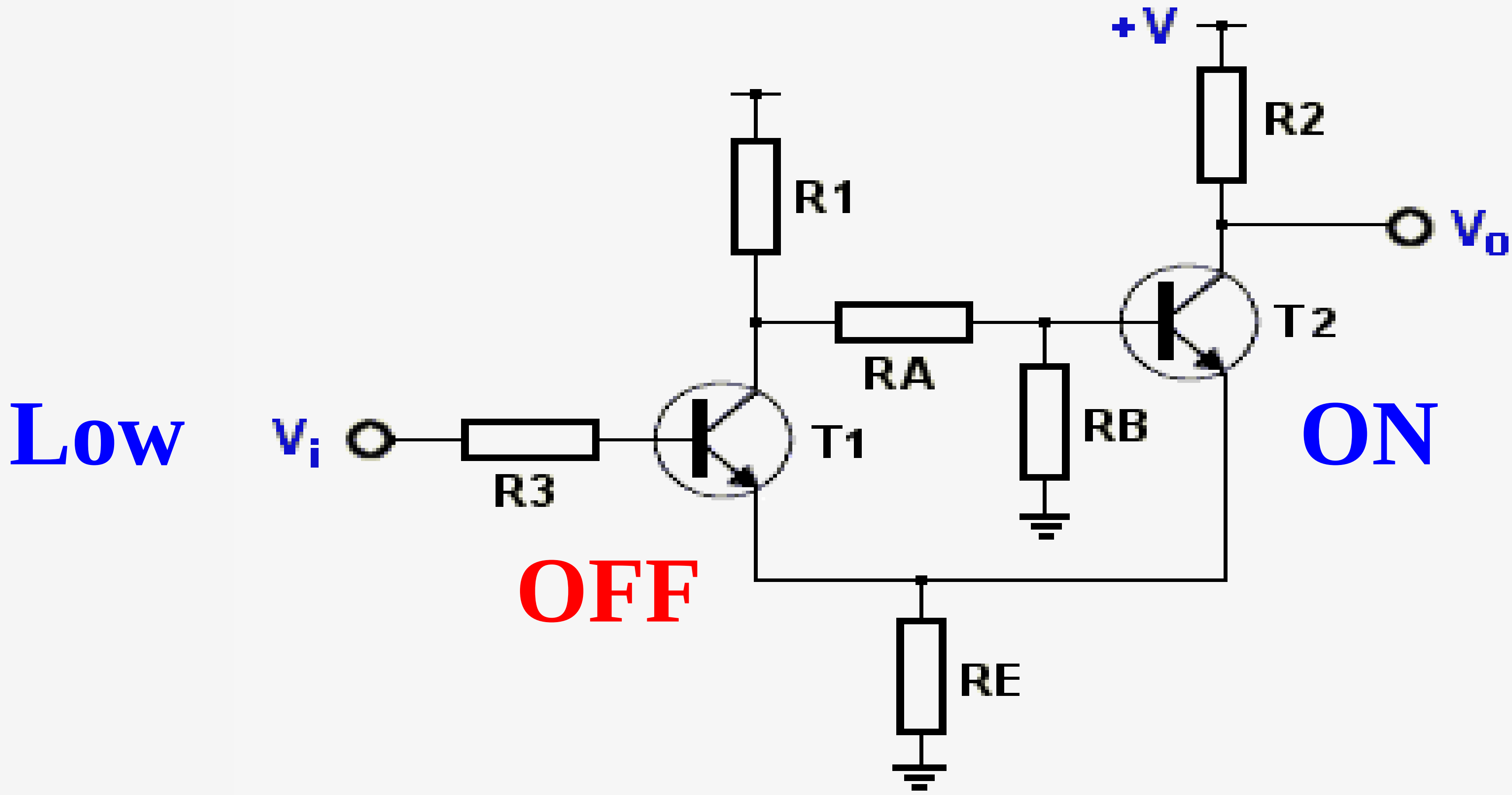


Figure 3.14 The two-transistor Schmitt trigger

Schmitt Trigger

V_P, V_N

Operation

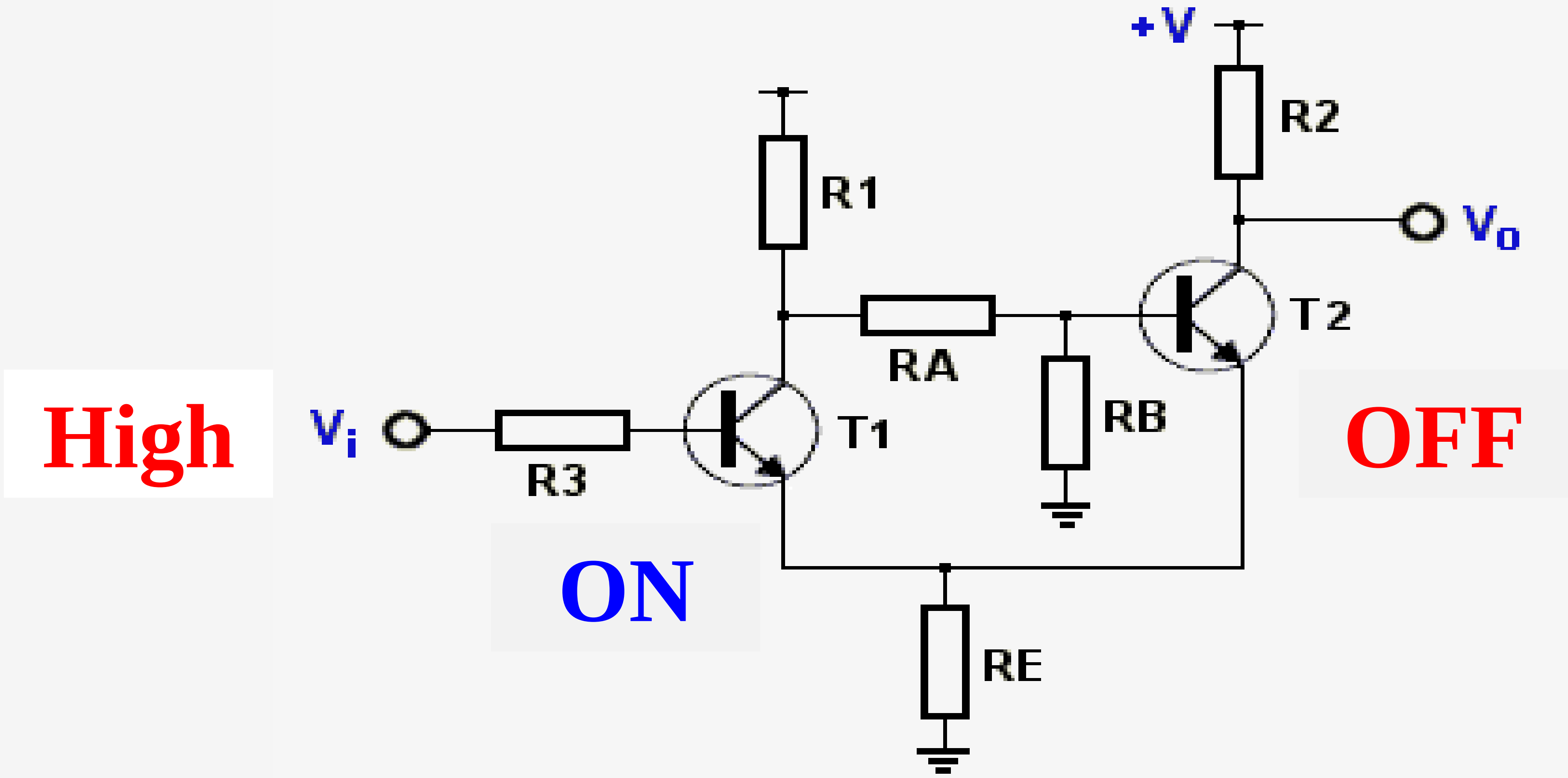


Figure 3.14 The two-transistor Schmitt trigger

Schmitt Trigger

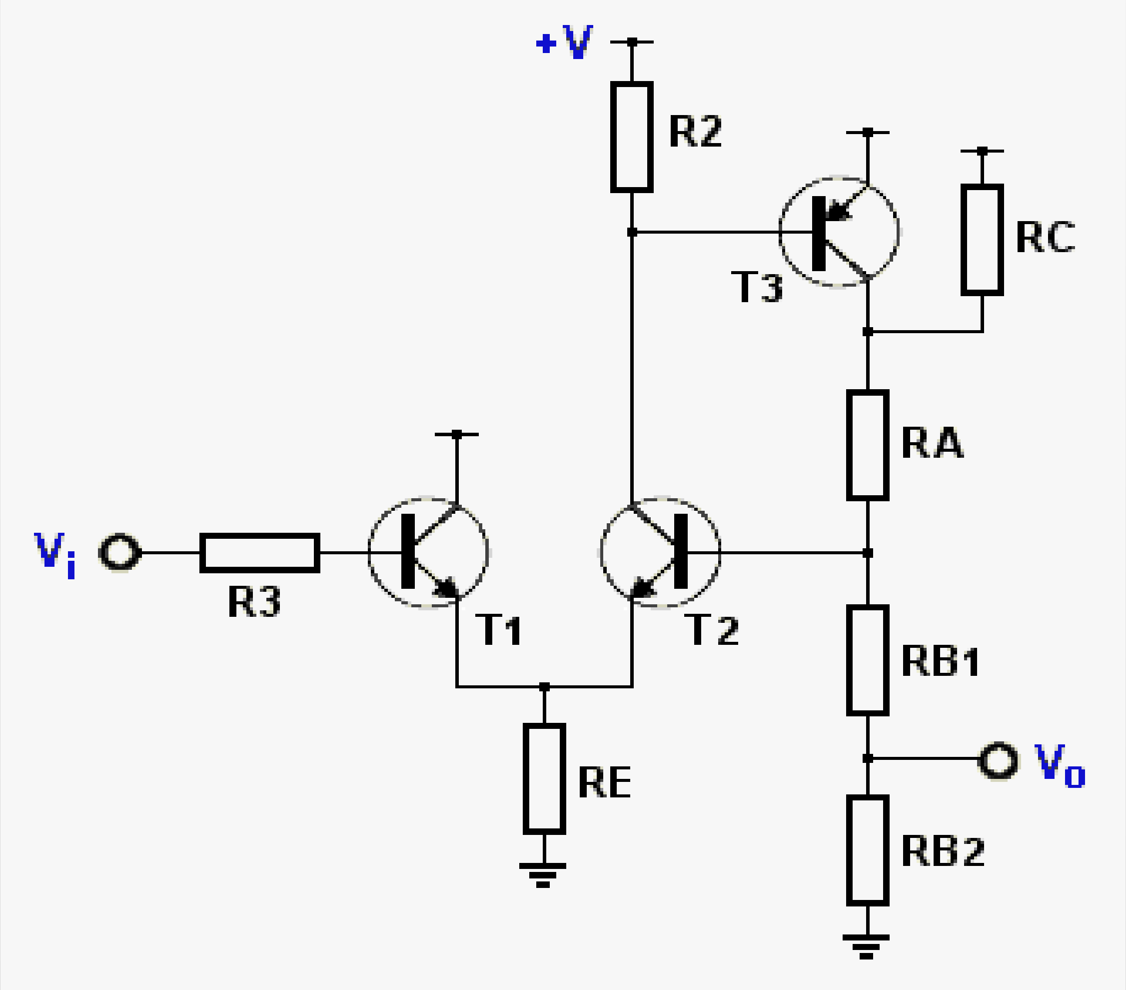
The current in T_1 (I_1) is smaller than the current in T_2 (I_2), or the circuit won't work!

V_N must be lower than V_P .

The difference between the two thresholds is known as the circuit's 'hysteresis'.

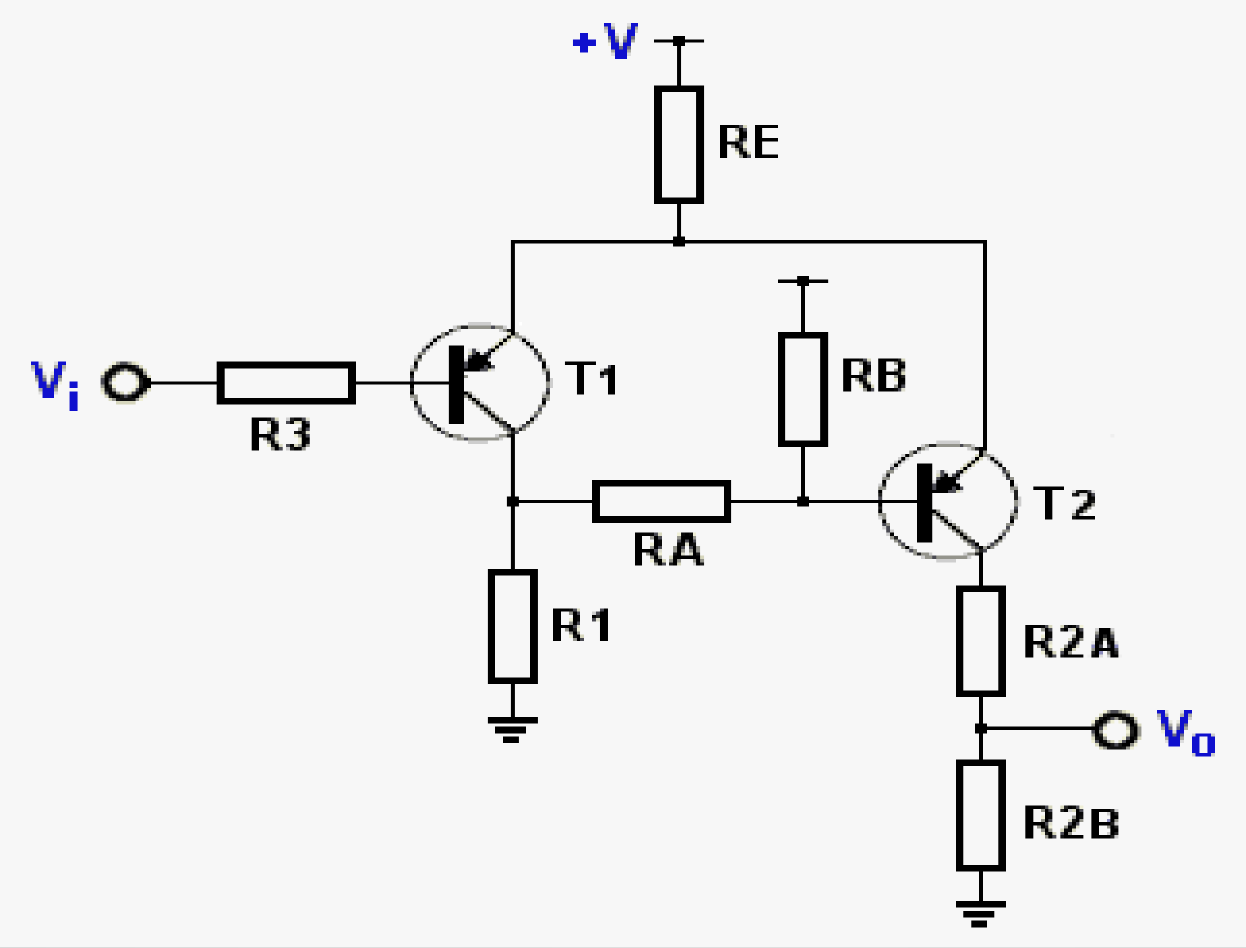
Schmitt Trigger

An alternative approach using three transistors



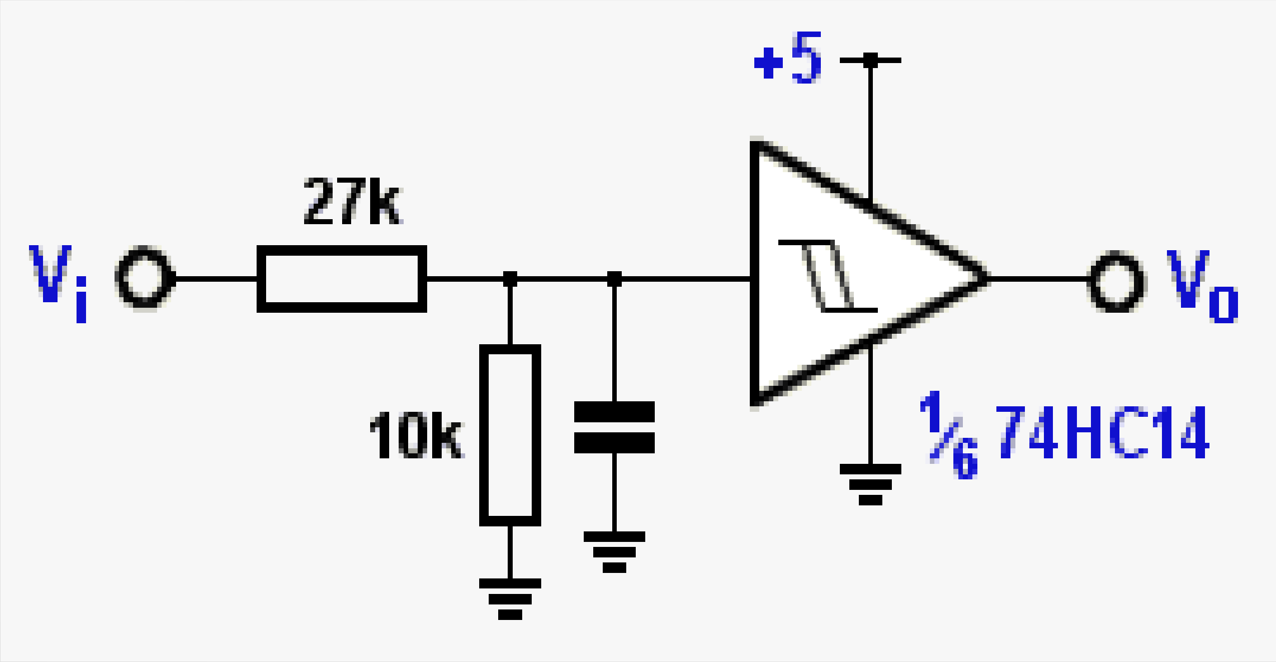
Schmitt Trigger

A simpler alternative



Schmitt Trigger

An even simpler alternative



THANK YOU

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